ATOFINA Chemicals, Inc.

March 28, 2003

The Honorable David Garman, Assistant Secretary
Office of Energy Efficiency & Renewable Energy
U.S. Department of Energy
1000 Independence Ave. SW
Washington, DC 20585

Dear Assistant Secretary Garman:

We are writing to express our deep concern about the recently proposed modifications to the ENERGY STAR Windows program. This program has been very successful in promoting the use of energy efficient products, and has become an extremely important standard in the residential fenestration industry. However, recent proposed changes threaten to seriously undermine the credibility of this successful program, as well as cause serious and irreversible harm to sections of the industry. The ENERGY STAR Windows program is valuable to the industry, and we would like to assist you in preserving the integrity of this important program.

The three-zone proposal must not be adopted. The Department's rationale for favoring this proposal is based upon conclusions and inclinations that are not supported by the data, as described in our attached detailed analysis.

Specifically, the DOE is favoring a proposal which:

- has 20% lower national energy savings potential than the four-zone proposal;
- has 18% lower potential reduction of greenhouse gases than the four-zone proposal;
- treats cities such as Phoenix and New York as the same, despite drastic climate differences;
- increases consumer heating costs;
- is inconsistent with current IECC codes, as well as the DOE proposed climate zones;
- threatens to eliminate an energy efficient technology, pyrolytic low-e (the most energy efficient technology in the northern half of the country);
- decreases choice in the marketplace, increasing cost to the consumer;
- eliminates an easier-to-use, low investment technology for small window manufacturers attempting to enter the low-e market;
- forces added costs onto window manufacturers for retooling, inventory management, and training to handle sputtered low-e;
- was already rejected once before, and reissued without any new analysis to address its flaws.

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The Department is favoring the three-zone proposal based upon a supposed large amount of cooling and peak load savings. However, the bulk of the cooling savings (70%) will occur even if no changes are made to the current ENERGY STAR Windows program. Both the four-zone and three-zone proposals provide additional cooling savings, but the three-zone proposal actually reduces heating savings relative to the current program. How can the DOE say heating is less important than cooling when nationally, consumers spend three times as much on heating than on air conditioning, and natural gas prices are at a record high? It certainly cannot justify eliminating pyrolytic low-e coatings, a low cost energy-efficient technology. Also, the potential peak load savings are statistically insignificant (less than 0.02% of the national peak load), and there is currently a substantial surplus of electricity generating capacity (over 30% reserve, forecast to grow to 50% in 2006). *Total* energy savings are the mandate of the program, not overstated claims of just cooling or peak energy savings.

The four-zone proposal is the next best option, in that it:

- provides greater national energy savings;
- recognizes the differences in climate across the country;
- reduces energy bills of consumers in all regions of the country;
- allows both low-e technologies to compete, preserving choice in the marketplace.

However, both proposals are limited in that they focus on arbitrary criteria without properly considering overall performance. In the North, the criteria treat windows like an opaque wall, only specifying U and ignoring the benefits of high solar heat gain to significantly reduce heating costs. This allows products which block out the warmth of the sun in winter to still qualify for the Energy Star label, despite inferior performance. This misleads the consumer. One solution is to consider a *minimum* SHGC requirement in the North.

The best solution is a true performance based standard, which appropriately reflects the tradeoffs between U and SHGC in each region. For instance, an aluminum window with U = 0.42 should not be excluded in the south central region if it has an appropriately low SHGC to give the same overall energy performance. Likewise, a low-e window with U = 0.38 should not be excluded in the northern region if it has an appropriately high SHGC to give the same overall energy performance. By ignoring these tradeoffs, the Department's ENERGY STAR program has an anticompetitive impact in the market by improperly promoting certain products as energy efficient over others, despite equal performance.

A performance based standard is not any more complex than the current system. Your ENERGY STAR program delivers simplicity to the consumer by virtue of the ENERGY STAR label itself. You should not allow the integrity of your program to be jeopardized by those in the industry who are willing to sacrifice energy performance to the consumer in their own interest of simplicity. The industry should be held to a higher standard, especially when the supposed complexity may not even be real. For example, the equations and methods for determining U and SHGC values are extremely complex, yet there are computer tools to make this easy, and this is not viewed as problematic in the current ENERGY STAR system. Likewise, U and SHGC tradeoff equations or tables could easily be incorporated into simple computer tools and labeling software for the window manufacturer. The outcome to the consumer is the same … the simple and clear ENERGY STAR label.

Performance based systems are either already used or being actively developed in Europe, Canada, Britain, Denmark, and Australia. The U.S. is clearly falling behind the rest of the world. The Department and industry has suffered through two years of controversy and frustration over the ENERGY STAR Windows program. To resolve this issue, the Department has no other choice than to step back, and take the time to develop an appropriate and fair performance based standard. We will be happy to assist in this process.

Sincerely,

Arthur Van Nostrand
President, Worldwide Additives Group
ATOFINA Chemicals, Inc.

Supplemental Detailed Analysis

The underlying criteria for the overall ENERGY STAR Program are to increase the technical energy performance potential of products, make it cost-effective for the consumer, save energy, and reduce green house gas emissions. Furthermore, the DOE has stated their objectives for their proposed changes to the ENERGY STAR Windows Program are to increase energy savings, meet or exceed code requirements, and offer a consumer-friendly approach to selecting high-performance windows.[1]

Below, we present the issues and concerns we have with the DOE's three-zone proposal, and how it fails to achieve the Department's basic requirements of the program.

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1. Market Impact on Low-E Technologies, Window Manufacturers, and the Consumer

1.1 Low-E Availability

There are two types of energy efficient coatings: pyrolytic or "hard coat" low-e, and sputtered or "soft coat" low-e. Pyrolytic low-e technology gives a SHGC around 0.50-0.54 in typical windows, and can currently be used in the upper two-thirds of the country. The most common sputtered low-e technology gives a SHGC around 0.30-0.34 in typical windows, and can be used in all regions. Sputtered low-e products with higher SHGC are also available, but are more common in Canada and Europe than in the U.S. Both pyrolytic and sputtered low-e technologies provide good insulating properties and low U values.

By virtue of the 0.4 maximum SHGC requirement, the three-zone proposal would prevent pyrolytic low-e products from being used in two-thirds of the country. Furthermore, window manufacturers who currently supply pyrolytic low-e windows have made it clear to the glass manufacturers that they will not stock two separate products when one (pyrolytic low-e) can only be used in the small northern market. Even though ENERGY STAR is technically a voluntary program, the program has gathered enough force to become a *de facto* market requirement. One version of the energy bill under debate in Congress ties tax rebates to ENERGY STAR, again underscoring its significance as a market requirement. If the three-zone proposal is implemented, nearly all window manufacturers will be forced to switch to sputtered low-e to supply the central region, eliminating pyrolytic low-e from the North American market. Eliminating high SHGC low-e from the U.S. market removes the most energy efficient glazing for the northern half of the country (see energy analysis below), forcing northern consumers to unwittingly suffer the consequences of lower energy performance. Furthermore, to increase the technical energy performance potential of products, two or more technologies must compete. If one is removed, the lack of competition will limit research investment into future advancements of efficient products to benefit the window industry and consumers.

On the other hand, the four-zone proposal allows pyrolytic low-e to meet the requirements in both the upper central and northern regions, covering enough of the market that many window manufacturers would continue to stock one type of low-e glass for northern climates and another for southern climates. As shown below, this business model maximizes national energy savings by using the appropriate high SHGC low-e product for the north, and the appropriate low SHGC low-e product for the south. The sputtered low-e technology can continued to be used in all regions without change, and the companies who manufacture or use it would not be affected in any way. Competition and choice in the marketplace would be preserved with the four-zone proposal.

1.2 Impact on Window Manufacturers

The DOE's three-zone proposal would eliminate pyrolytic low-e technology from the market, adversely affecting many window manufacturers. Pyrolytic low-e glass is a low cost, easy-to-use technology for window manufacturers. Because of its durability, pyrolytic low-e glass requires no special fabrication equipment, training, or inventory control, making it easier for smaller, regional window manufacturers to enter the low-e window market. Eliminating the choice of low-e technology places a burden on window manufacturers who would incur additional costs associated with using sputtered low-e (edge deletion equipment, special washers, training, and inventory control). This can total up to $150,000 per location, not including training. It is likely many smaller window

[1] ENERGY STAR Windows Announcement Letter, U.S. Department of Energy, February 11, 2003.

manufacturers could not afford this burden. As there are between 800-1200 window manufacturers, widespread adoption of ENERGY STAR will require the participation of these small manufacturers.

Furthermore, by eliminating pyrolytic low-e, the three-zone proposal would impair the ability of many window manufacturers to compete effectively in the Upper Central and Northern Regions, even though they are marketing a more energy efficient product. The proposal is structured to favor a single glazing product strategy throughout the United States at the expense of energy efficiency and to the detriment of market forces. Hence, those window manufacturers who are marketing the most efficient products for the region are being penalized. The three-zone proposal:

- Increases the regional manufacturer's costs for participating in the energy efficient windows market (investment in equipment and training to fabricate low SHGC low-e windows along with uncompetitive pricing for lower volume purchasers of soft coat glass and/or insulated glass units).

- Eliminates regional manufacturer's ability to effectively market a high SHGC superior energy-performing product in their region (against manufacturers that are marketing the same low SHGC glass in Minnesota as in Florida).

- "Squeezes out" the regional manufacturer from the residential energy efficient windows market, and ultimately out of the entire residential windows market as all home windows will eventually be required to be energy efficient.

On the other hand, the four-zone proposal allows smaller, regional window manufacturers to remain in the energy efficient windows market. Window manufacturers can continue to capitalize on the handling ease and durability of pyrolytic low E glass. Choice of window glazing will be upheld to both the window manufacturers and the consumers who derive the greatest benefit in energy savings.

1.3 Impact on the Consumer

Cost-Effectiveness for the Consumer

The production costs to manufacture and handle pyrolytic low-e glass is lower than the costs to produce and handle sputtered low-e glass. These costs are added up and put into the final window product sold to the consumer. Consumers should have a choice in technology for selecting the most cost-effective window, and also saving the greatest amount of energy. The four-zone proposal allows homeowners the choice between pyrolytic low-e technology and its effects on reducing heating costs, and sputtered low-e technology and its properties to reduce cooling costs. On the other hand, the three-zone proposal takes away consumer choice in the Central region, and ultimately in the Northern region, as pyrolytic technology will be eliminated. Smaller regional window manufacturers who cannot compete effectively with DOE's proposal will operate unprofitably and eventually close. As a result, consumers will have less choice in the market, and will be required to pay even more for energy efficient windows which will eventually be the only windows available (if the ENERGY STAR program is successful). ENERGY STAR's message to the consumer will lose credibility if consumers are faced with less choice, coupled with higher prices from the resulting low supply/high demand situation.

Consumer-Friendly Approach to Selecting High Performance Windows

An additional goal of the DOE is to offer the consumer a friendly approach to selecting energy efficient windows. It is the responsibility of the DOE and the window industry to ensure consumers are buying products for their energy saving needs, which goes back to why the ENERGY STAR label is used – to promote the most energy efficient products for each region. For window manufacturers, a change in the labeling system will be required regardless whether the three-zone proposal or four-zone proposal is implemented. One argument for the three-zone proposal is simplicity. However, window manufacturers have indicated it would be a simple change in their system software to label for the four-zone proposal. An inconvenience to the window manufacturer should not dominate over energy savings to the consumer, a person whose key reasons for buying an energy efficient window is to reduce energy costs for their home.

Consumers do not need to understand all the details of how U and SHGC criteria are set for ENERGY STAR windows and the ramifications of these criteria on energy performance. They only need to be guided to select the most energy efficient windows. The ENERGY STAR label is the only guidance they will need, which gives simplicity to the consumer. The four-zone map will allow the consumer to locate where he or she lives, and be assured they are buying the most energy efficient product feasibly available to him or her.

2. Energy Performance

2.1 National Energy Savings

As stated, saving energy is a primary goal of the ENERGY STAR program. The EPA and DOE use the ENERGY STAR label to promote the most energy-efficient products in the market. The most energy-efficient window for a consumer is dependent on where the consumer lives. Low solar gain low-e windows will save the most energy for a homeowner who lives in the South and South/Central regions like Miami and Phoenix because it reduces the amount of the sun's energy entering the home, which add to air conditioning costs. However, low solar gain windows will save less energy in northern and upper central climates. In these climates, the sun's energy helps to offset heating costs and overall energy use. High solar gain low-e windows which let in the sun's energy save the greatest amount of energy for homeowners in the North and North/Central regions of the U.S., like those who live in Boston, Chicago, and even Raleigh, NC.

Analysis Error: In the DOE's analysis of the three-zone proposal, Reno NV was mistakenly placed in the Northern region rather than the Central region. When this error was corrected, the results are as follows:

Annual Energy Savings Potential relative to current sales (trillion Btus)

Scenario	Heating Savings	Cooling Savings	Total
Current Energy Star	1.3	6.6	7.9
Three-Zone (corrected)	0.6	9.4	10.0
Four-Zone	4.1	7.9	12.0

By the Department's own analysis, the four-zone proposal, which allows the use of high solar gain low-e windows in the North and North/Central regions, provides 20% greater energy savings potential than the three-zone proposal. Since saving energy is the primary goal of the ENERGY STAR program, the only proposal that is appropriate to meet consumer, environment, and the Department's needs is the four-zone proposal.

Cooling vs. Heating

The DOE clearly states their belief that cooling savings and reduced electrical demand are more important than heating savings.[1,2] However, *total* energy savings are the mandate of the program. Heating is as important, if not more important, as cooling. Nationwide, heating accounts for 3 times that of cooling in total energy consumption of homes.[3] Recent forecasts show natural gas shortages and high natural gas prices for at least the next three years, whereas there is a 30-50% surplus of electrical capacity.[4,5]

An important point is that the bulk of the cooling savings (70%) will be achieved even if the DOE does nothing and stays with the *current* ENERGY STAR criteria. The choice of baseline for the analysis has resulted in an incorrect point of view. To accurately evaluate the impact of a change in the program, the energy savings should be compared to the current Energy Star program rather than the "sales scenario" baseline. This is shown in the table below:

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2 *Decision Factors: Options for new Energy Star Criteria for Windows, Doors, and Skylights*, U.S. Department of Energy, Washington D.C., February 11, 2003.

3 *1997 Residential Energy Consumption Survey*, Energy Information Administration, U.S. Department of Energy, Washington D.C.

4 "Natural Gas Prices Hit Record Highs", Reuters, February 25, 2003.

5 R. Smith, "Surplus of Electricity Supplies May Persist at least until 2005", Wall Street Journal, February 12, 2003.

Annual Energy Savings Potential relative to Current ENERGY STAR (trillion Btus)

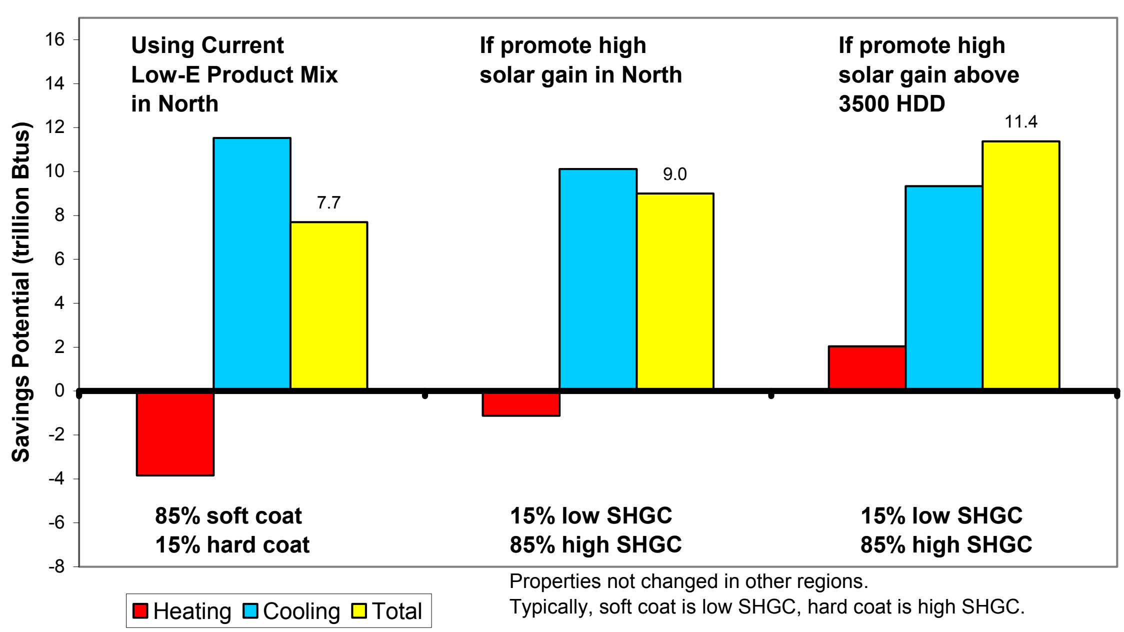
Scenario	Heating Savings	Cooling Savings	Total
Three-Zone	(0.7)	2.8	2.1
Four-Zone	2.8	1.3	4.1

This demonstrates that the true cooling savings associated with the three-zone proposal are no longer so dramatic, and the three-zone actually reduces the heating savings relative to the current program. On the other hand, the four-zone proposal is more balanced between heating and cooling savings, benefiting consumers in all regions of the country. By favoring the three-zone proposal based upon the "large" amount of cooling savings and ignoring the difference in total energy savings, the DOE has made an erroneous conclusion not supported by the data.

Maximizing National Energy Savings

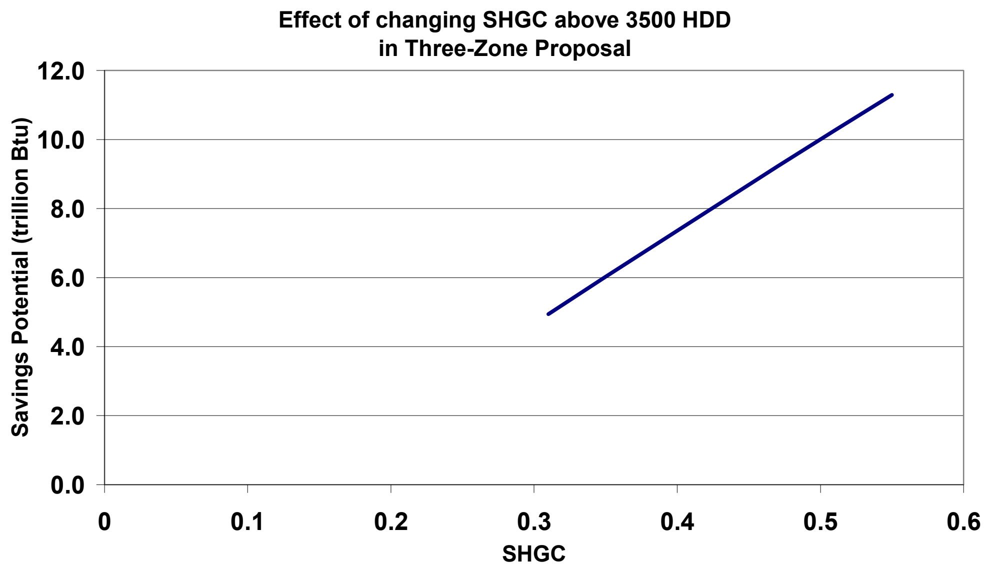
In addition, by failing to promote the most energy efficiency products for consumers, the DOE's three-zone proposal does not maximize national energy savings in the upper central and northern regions. By imposing a maximum SHGC requirement in the upper central, and by not imposing a *minimum* SHGC requirement in the north, passive solar heating (a free renewable energy source) is wasted.

The DOE evaluation model uses window properties of U = 0.35 and SHGC = 0.55 in the north, unrealistically combining the thermal properties of a good low-e window with the high solar heat gain of a clear glass unit. As shown in the chart below, if the current low-e product mix in the north is used in the three-zone analysis (85% soft coat with typical U=0.32 and SHGC=0.31, 15% hard coat with U=0.35 and SHGC=0.51),[6] the total savings potential is reduced by over 20%, and the heating savings are reduced by 4.4 trillion BTUs. On the other hand, if the ENERGY STAR for Windows program follows its mission to promote the most energy efficient products in these regions (high SHGC), the savings can be dramatically increased.



[6] *Study of the U.S. Market for Windows, Doors, and Skylights*, Ducker Research Company, 2002.

Illustrated alternatively in the chart below, DOE's model clearly shows that national energy savings potential increases with increasing SHGC above 3500 HDD. Therefore, the DOE's reduction of the SHGC requirement in the upper central region is plainly in conflict with their stated objective of maximizing national energy savings.



Breadth of "Central Region"

It is clear that at least two distinct climate zones exist in the Central Region. DOE's proposed three-zone criteria treats all cities in the Central Region the same, even though the climates are vastly different. For example, New York and Philadelphia, which are in the Upper Central, are in a completely different climate than Phoenix and Dallas, which are in the Lower Central. It is wholly inappropriate that the Upper Central and Lower Central Regions, which do not share the same climate, share the same ENERGY STAR criteria.

By creating one large Central region across diverse climates from Texas to New York, it is impossible to maximize national energy savings. Instead, the lower central region benefits at the expense of the upper central region. This is clearly evident in the existing construction portion of DOE's analysis.

Region	Existing Construction Savings potential relative to Current Energy Star (trillion btus)
2000-3500 HDD	+0.37
3500-6000 HDD	- 0.62

It is impossible to estimate similar tradeoffs for the new housing portion of DOE's model, because the analysis is based on U.S. Census regions, averaging out the energy savings and housing starts across many climate zones. This is especially true in the Pacific region (e.g. San Diego to Seattle), Mountain region (e.g. Phoenix to Boise), and the South Atlantic region (e.g. Miami to Baltimore).

On the other hand, the four-zone criteria allow a distinction of climate within the Central Region, as it separates the area into North/Central and South/Central zones. This is more appropriate and consistent with the detailed work performed at Pacific Northwest National Laboratory to more accurately define climate regions in the country.

2.2 Homeowner Energy Usage above 3500 HDD

At the consumer level, the proposed three-zone criteria will promote window products that will increase homeowner energy consumption in the Northern and Upper Central Regions of the country. At a time when natural gas prices are at a record high, it is not appropriate to promote criteria that save less energy. An estimated 15% price increase is expected in natural gas, but because of additional consumption this winter, actual consumer heating bills are expected to be higher.[4]

- By limiting the SHGC in the Upper Central Region (3500-6000 HDD), the three-zone proposal eliminates the most energy efficient products from the ENERGY STAR program even though they provide greater annual energy performance in this region over products that will meet the proposed criteria. As demonstrated by the charts below, consumers in cities such as New York and Philadelphia significantly benefit from a high SHGC product which reduces their heating costs, and thus, overall energy costs. Although lowering the SHGC requirement to less than 0.4 provides a cooling season benefit to consumers in this region, the annual utility costs for many homeowners in this region are dominated by the heating season. Nationwide, consumers spend three times more for heating than for cooling, and even more in this region.[3] Additionally, by eliminating the choice of a high SHGC low-e window, the three-zone proposal severely restricts a consumer's ability to choose windows for their own personal comfort level.

- In the Northern Region (>6000 HDD), the DOE proposal does not effectively promote superior performing products, allowing inferior products to receive the ENERGY STAR label (see charts, below). Allowing these inferior products to receive the ENERGY STAR label directly contradicts the DOE's stated objectives of promoting energy savings and superior performance. Northern consumers benefit substantially by using high SHGC windows, which allow their home to capture free, 100% renewable solar energy. On the other hand, homeowners using low SHGC products in this region will consume more energy annually, as well as pay more for these "energy efficient" windows.

On the other hand, the proposed four-zone criteria allow the most efficient windows to remain in the North (above 5400 HDD) and North/Central (3600 to 5400 HDD) regions of the Energy Star Program. Higher SHGC products in these heating-dominated climates help conserve energy. Savings would be increased further with a *minimum* SHGC requirement.

- Separating the Central region into the North/Central (3600 to 5400 HDD) and South/Central (6300 to 4500 CDD) will allow the most energy efficient products to be promoted in these regions. Consumers in the North/Central region benefit from windows with high solar heat gain low-e, as they use more heating than cooling. High SHGC windows will help reduce consumer heating costs in the North/Central region, and thus, overall annual energy usage. For consumers in the South/Central, windows with low SHGC will help reduce air conditioning use.

- Although the Northern Region (>5400 HDD) criteria will continue to allow high SHGC products, the DOE four-zone proposal does not effectively promote the most energy efficient products. Similar to the three-zone, allowing products with low SHGC to receive the ENERGY STAR label directly contradicts the DOE's stated objectives of promoting energy savings and superior performance. Northern consumers benefit substantially by employing high SHGC windows, which allow homes to capture free, 100% renewable solar energy, and thus, reduce their heating costs. On the other hand, homeowners using low SHGC products in this region will consume more energy annually.

- The four-zone proposal preserves a high performing energy efficient technology, namely pyrolytic low-e, in the market. This upholds choice of window glazing technology for both window manufacturers and consumers, giving the consumer the choice of selecting the most energy efficient windows for where they live.

Product Comparison of Annual Energy Performance

The charts on the following pages compare the annual energy consumption (heating + cooling) impact of various types of glazings in a typical home in different cities in the Upper Central and Northern regions. Vinyl framed, argon-filled double glazed windows were used, where only the type of glazing was varied. Calculations were done in accordance with NFRC 901 proposed guidelines using RESFEN 3.1 software based upon the U.S. Department of Energy calculation method (DOE 2.1E). The window properties, including angular dependence data, were calculated with Window 4.1 and imported into the RESFEN 3.1 program. To determine the individual impact of each glazing type on the home's annual energy consumption (heating + cooling), the energy usage of the home without windows was subtracted from energy usage of the home with windows for each of the window types described below, in each of the cities. Positive values for this difference represent the relative increase in home energy consumption contributed by the windows with the various types of glazing products. Negative energy values indicate that the corresponding window/glazing combination actually provides superior energy performance over that of an insulated wall in that particular location. Therefore, the best energy performance is represented by the products with the lowest or negative value bars.

The following basic assumptions were employed and held constant for each run in the simulation study:

House

- Single story, new frame, 2000 ft^2 floor area
- Window Area: 300 ft^2, equally distributed on the North, South, East and West walls
- "Typical" shading as defined by RESFEN 3.1 (interior shades, overhangs, trees and neighboring buildings)
- "Typical" foundation and envelope insulation for each location as listed in NFRC 901 or the RESFEN 3.1 manual

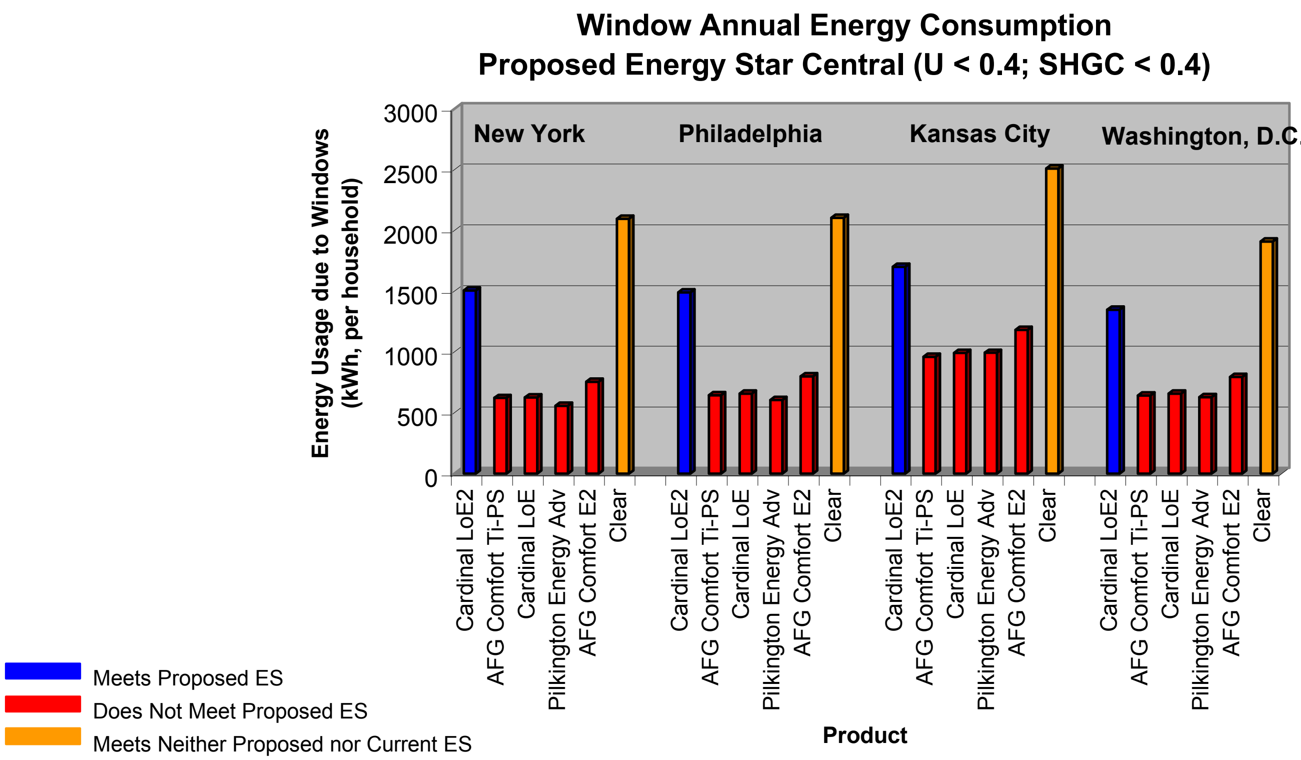
Windows

- 2 ft × 4 ft Casement
- Vinyl Frame
- 0.3 cfm/ft^2 air infiltration rate
- Argon filled Insulating Glass Unit, butyl/metal spacer, 1/2" gap
- 3 mm glass

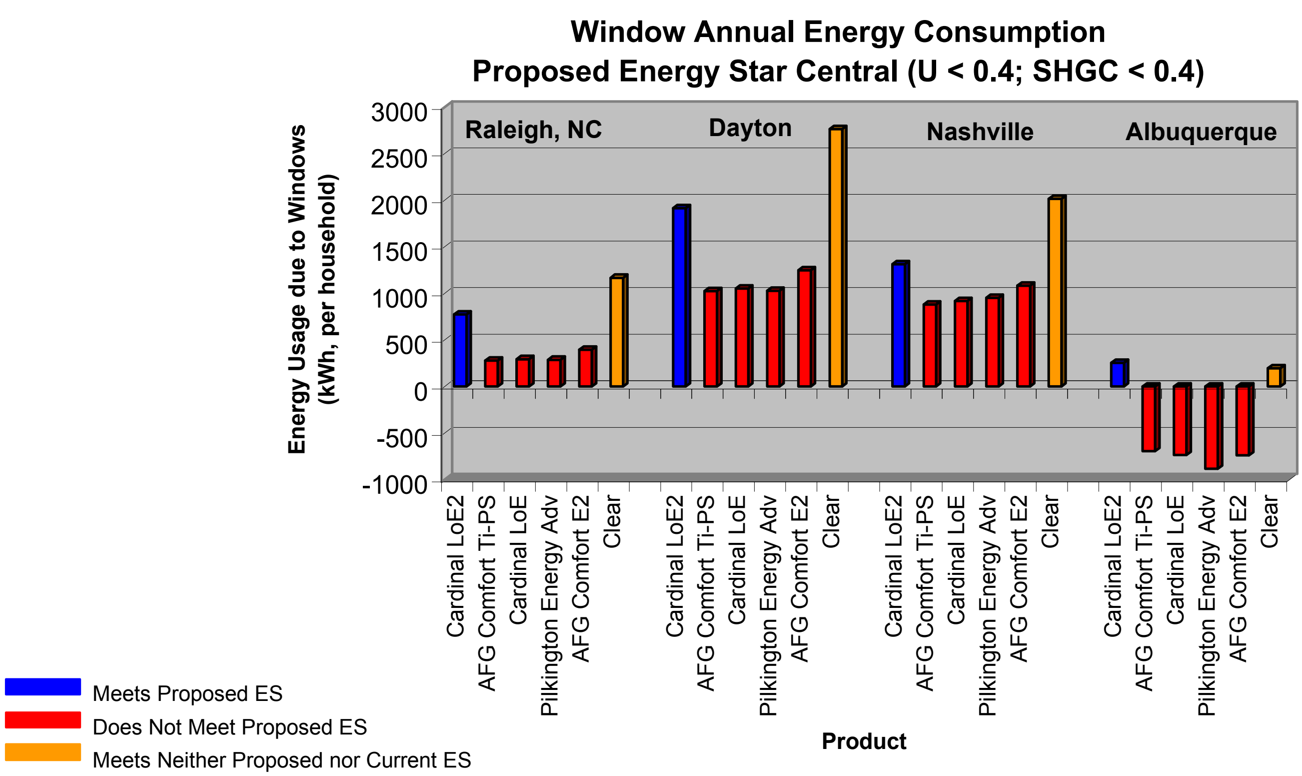
The full assumptions underlying the simulations are listed in NFRC 901, the RESFEN 3.1 manual, and the Window 4.1 manual.

Window Properties:

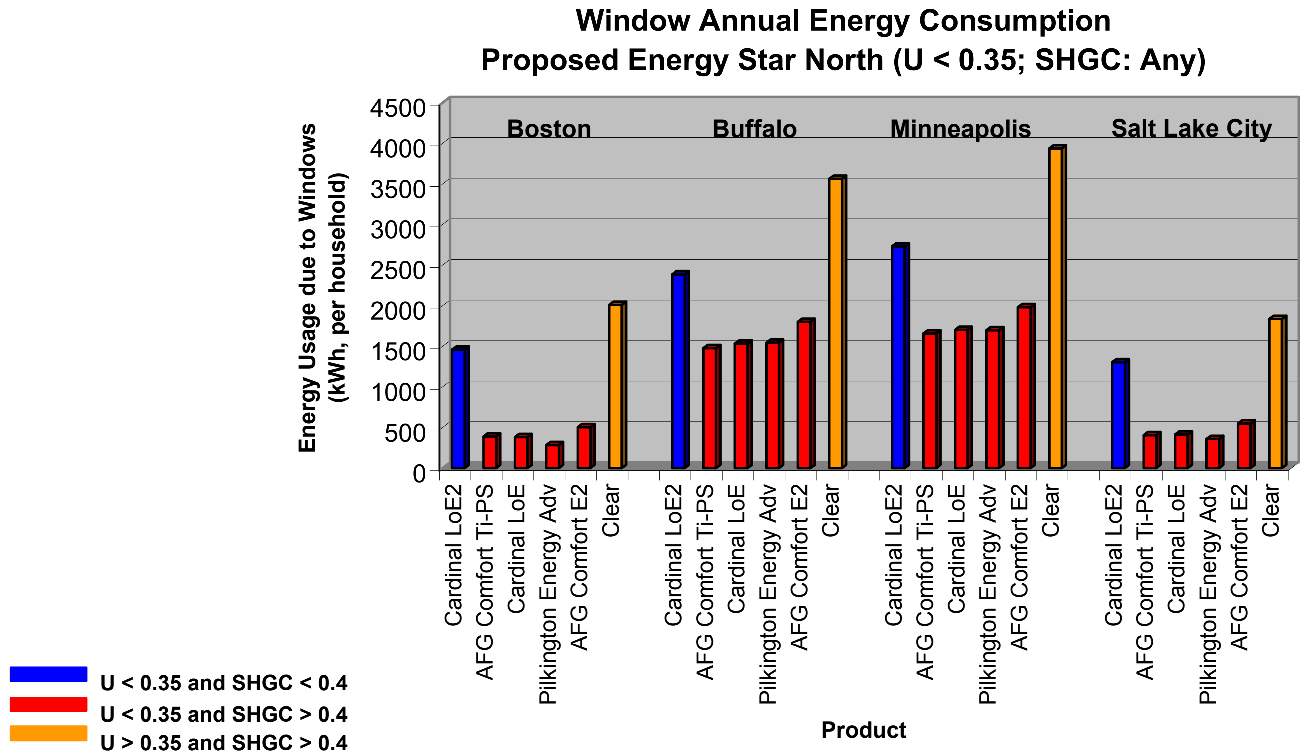
Glass Coating Type	**Representative Product**	**Window U (BTU/ hr-ft^2-^oF)**	**Window SHGC**
Clear glass	--	0.42	0.55
Low SHGC sputtered low-e	Cardinal LoE^2	0.28	0.31
Moderate SHGC sputtered low-e	AFG Comfort Ti-PS	0.28	0.43
Moderate SHGC sputtered low-e	Cardinal LoE	0.29	0.45
High SHGC pyrolytic low-e	Pilkington Energy Advantage	0.31	0.51
High SHGC pyrolytic low-e	AFG Comfort E2	0.32	0.51

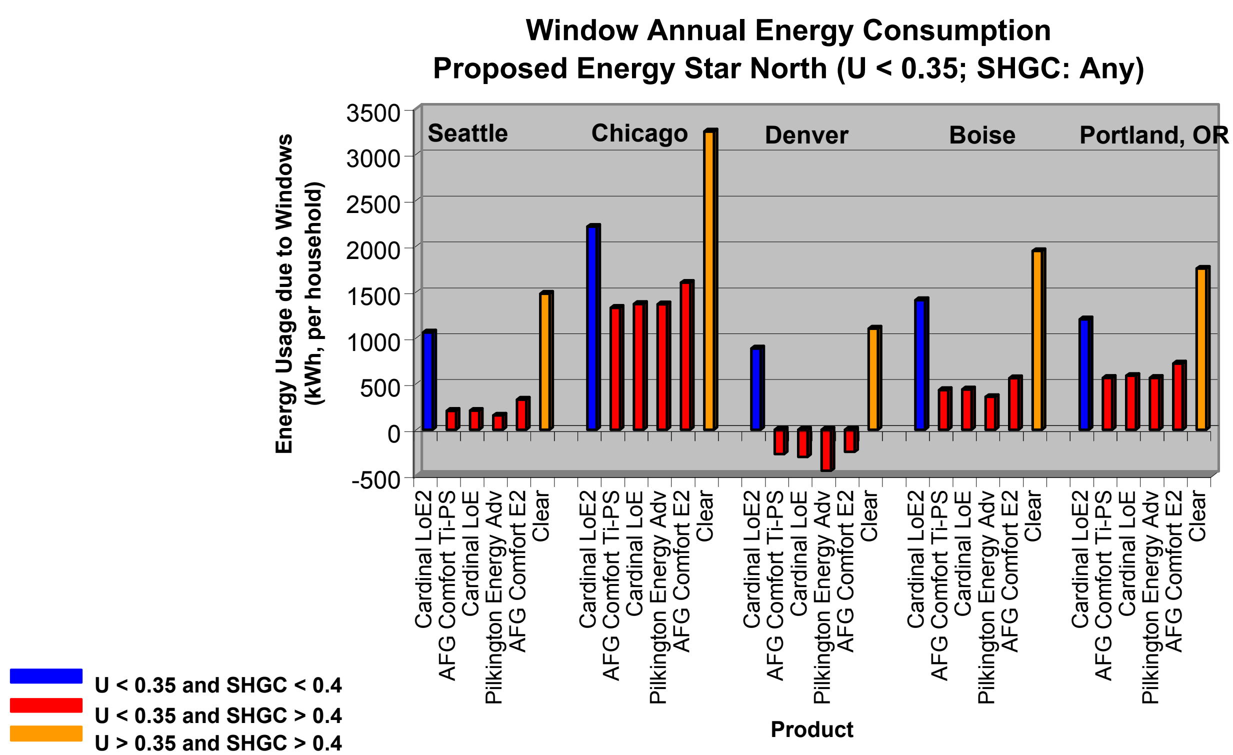


Window Annual Energy Consumption
Proposed Energy Star Central (U < 0.4; SHGC < 0.4)
Energy Usage due to Windows (kWh, per household)
3000
2500
2000
1500
1000
500
0
New York
Philadelphia
Kansas City
Washington, D.C.
Cardinal LoE2
AFG Comfort Ti-PS
Cardinal LoE
Pilkington Energy Adv
AFG Comfort E2
Clear
Product
Meets Proposed ES
Does Not Meet Proposed ES
Meets Neither Proposed nor Current ES



Window Annual Energy Consumption
Proposed Energy Star Central (U < 0.4; SHGC < 0.4)
Energy Usage due to Windows (kWh, per household)
3000
2500
2000
1500
1000
500
0
-500
-1000
Raleigh, NC
Dayton
Nashville
Albuquerque
Cardinal LoE2
AFG Comfort Ti-PS
Cardinal LoE
Pilkington Energy Adv
AFG Comfort E2
Clear
Product
Meets Proposed ES
Does Not Meet Proposed ES
Meets Neither Proposed nor Current ES


Window Annual Energy Consumption
Proposed Energy Star North (U < 0.35; SHGC: Any)
Boston
Buffalo
Minneapolis
Salt Lake City
Energy Usage due to Windows (kWh, per household)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Cardinal LoE2
AFG Comfort Ti-PS
Cardinal LoE
Pilkington Energy Adv
AFG Comfort E2
Clear
Product
U < 0.35 and SHGC < 0.4
U < 0.35 and SHGC > 0.4
U > 0.35 and SHGC > 0.4


Window Annual Energy Consumption
Proposed Energy Star North (U < 0.35; SHGC: Any)
Seattle
Chicago
Denver
Boise
Portland, OR
Energy Usage due to Windows (kWh, per household)
3500
3000
2500
2000
1500
1000
500
0
-500
Cardinal LoE2
AFG Comfort Ti-PS
Cardinal LoE
Pilkington Energy Adv
AFG Comfort E2
Clear
Product
U < 0.35 and SHGC < 0.4
U < 0.35 and SHGC > 0.4
U > 0.35 and SHGC > 0.4

As illustrated by the results of window performance simulation studies, the DOE's three-zone proposal is inconsistent with the stated purpose of the ENERGY STAR program – to promote the use of the most energy efficient products available in the marketplace. In the Northern Region (>6000 HDD), this proposal actually inhibits the consumer from identifying the most energy efficient windows as it fails to distinguish the beneficial impact that a higher SHGC has on residential energy performance. By allowing the use of a low SHGC product, the DOE is encouraging passive solar energy benefits to be squandered. In the three-zone Central Region (2000 – 6000 HDD), this proposal sacrifices the energy performance of products marketed in this region's upper half (3500-6000 HDD) where high SHGC is appropriate, to favor the performance of products marketed in the lower half (2000 –3500 HDD) where lower SHGC is appropriate. In other words, applying a Southern SHGC to the Central region benefits consumers in Phoenix and Dallas (lower central region) at the expense of consumers in New York and Dayton (upper central region). The four-zone proposal allows a better separation of the country, such that consumers in the North/Central region, like New York, benefit from high SHGC windows, while consumers in the South/Central, like Phoenix, benefit from low SHGC windows.

2.3 Peak Load Impact

Peak load savings are insignificant

The DOE also favors the three-zone proposal due to the larger potential reduction in peak electrical demand as a result of the reduced solar heat gain coefficient in the central region.[1,2] First of all, total energy savings is the mandate of the program, not peak demand. In the upper central and northern regions, any residential peak load reduction as a result of decreased SHGC is minimal, and is achieved at the expense of much greater energy consumption in the winter. In the main area of contention, 3600-5400 HDD, the DOE evaluation has calculated that reducing a window's SHGC from 0.55 to 0.40 results in an average peak reduction of 250 W per home … only three lightbulbs. Peak energy demand is of concern for roughly 1% of the hours in a year, and peaking power plants are often designed for operation 3% of the year.[7] Using the conservative 3% design factor, this 250 W peak demand savings corresponds to only ~ 65 kWh cooling energy savings per home per year. Furthermore, this savings only comes at the sacrifice of passive solar heating in the wintertime. This same reduction in SHGC increases the total annual energy heating and cooling energy consumption by 400-1000 kWh per home. The proclaimed peak load benefit is clearly not worth the annual energy consumption cost.

Furthermore, the benefit of reduced SHGC is also insignificant even when purely considering peak energy reduction, regardless of total energy consumption. The DOE evaluation estimates that the 250 W peak savings per home corresponds to a total peak demand savings in the central region of 115 MW per year. In its published rationale, the DOE uses this peak demand savings as the basis for favoring the three-zone proposal, even though it has less total energy savings than the four-zone proposal, and would eliminate pyrolytic low-e technology from the market. However, this 115 MW potential savings is statistically insignificant … less than 0.02% of the U.S. summer peak load (681,449 MW in 1999),[8] and is achieved only at the expense of greater energy consumption in the winter. This number is far too small to be considered relevant as the accuracy of the total peak load requirement is by no way within a margin of error of ±0.02%! Again, the DOE's reliance on this number to favor the three-zone proposal is unjustified.

Even worse, the Department of Energy has ignored its own technical experts at Pacific Northwest National Laboratory whose recent analysis disputes the three-zone proposal's technical merit. This analysis shows that the potential consumer "economic benefits of lowering the SHGC in climate zone 4 (or above) do not justify the extension of this requirement into these climate zones" even when including the effects of peak load reductions.[9] Climate zone 4 is the same upper central region, covering 3600-5400 HDD.

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[7] S. Nadel, F. Gordon, C. Neme, *Using Targeted Energy Efficiency Programs to Reduce Peak Electrical Demand and Address Electric System Reliability Problems*, American Council for an Energy-Efficient Economy, Washington D.C., Nov 2000.

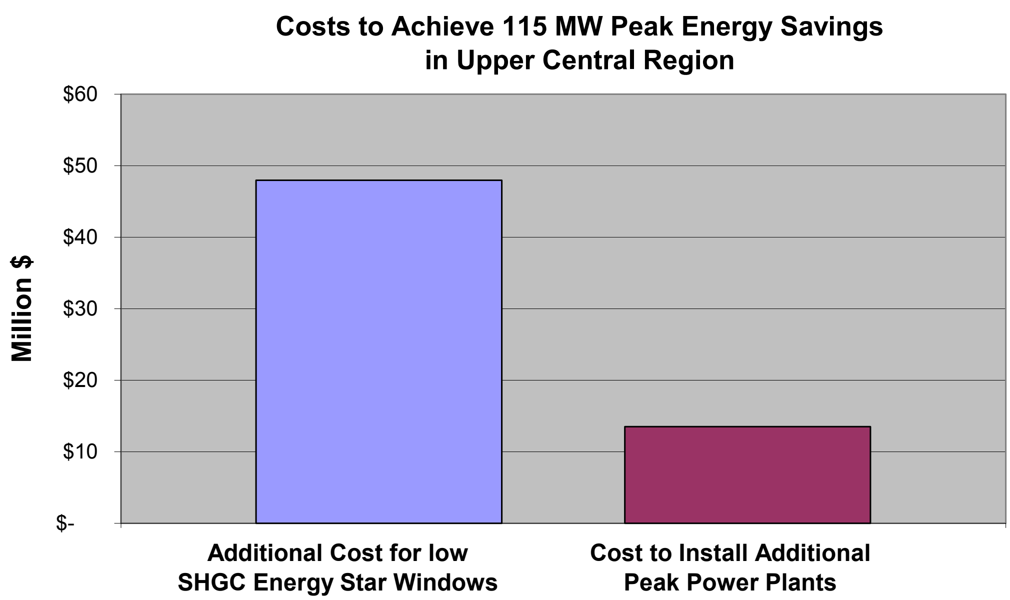
[8] *Annual Energy Review 2000*, Energy Information Administration, U.S. Department of Energy, Washington D.C., 2000.

[9] C. Conner, "Proposed Changes to Solar Heat Gain Coefficient Requirement for Residential Buildings in the International Energy Conservation Code", Pacific Northwest National Laboratory, Aug 2002.

Furthermore, statements of drastic peak energy shortages are inaccurate. There is currently a substantial surplus of electricity generating capacity with over 30% reserve, forecast to grow to 50% in 2006.[5] This is true in all regions: 31% reserve in the 11-state Western region growing to 56% in 2006, 29% reserve in the Northeast growing to 45%, and 30% reserve in the Southeast growing to 52%.[5] It is also evident that the 2000-2001 energy crisis in California was largely the result of market manipulation, rather than true supply issues. The State of California has presented evidence to FERC to this effect.[10]

Reducing peak demand by 115 MW annually through DOE's proposal will cost at least $48 million versus a cost of less than $14 million for installing 115 MW of new peak generation capacity. Using data from the ACEEE, installing an additional 115 MW peak energy capacity per year will cost approximately $5.4 million in capital, or approximately $14 million, if capital, operating costs, and transmission and distribution upgrades are included.[7] On the other hand, it will cost far more to achieve this peak load savings by installing windows which meet the proposed ENERGY STAR criteria. According to a recent survey by the NW Energy Efficiency Alliance, the incremental cost for installing ENERGY STAR windows vs. non-Energy Star windows is conservatively estimated at $0.45 / ft^2.[11] Using the same number of homes in the upper central and the same 40 year replacement cycle as the DOE evaluation,[12] and the 231 ft^2 average window area for the homes used in this analysis, an **additional $48 million** will have to be spent each year to achieve this peak load reduction by installing low SHGC ENERGY STAR windows. In other words, because the potential peak load reduction contributed by low SHGC windows is so small, it is less expensive to build the extra peaking power plants. Hence, promoting the ENERGY STAR Windows program as a cost-effective means of reducing peak power consumption provides a very weak and ineffective incentive for purchasing these windows.

The better and more effective argument for installing Energy Star windows is founded upon *total energy savings*, not peak load reduction. Clearly, DOE's stated objective of protecting the nation's power supply by reducing peak load through its ENERGY STAR Windows program is misguided and makes no economic sense for the nation. DOE should stick to its **mandate** of reducing total annual energy consumption rather than trying to achieve an uneconomical peak load reduction. DOE can further this mandate and achieve greater energy savings by promoting pyrolytic low E windows for the Northern and Upper Central Regions, achieving greater economic savings thereby.



[10] "California Mounts Energy Scam Case", Associated Press, March 3, 2003.
The complaint itself can be found at http://www.cpuc.ca.gov/static/industry/electric/ferc+206+complaint.htm

[11] *Market Progress Evaluation Report for the Energy Star Windows Project, No. 5*, Northwest Energy Efficiency Alliance, Jan 2002.

[12] E. Barbour and D. Arasteh, *An Evaluation of Alternative Criteria for Energy Star Windows*, U.S. Department of Energy, Washington D.C., February 11, 2003.

More effective ways to address peak load

As we have shown, the potential peak load savings from reduced SHGC in the upper central region is inconsequential. Furthermore, there are far better options to reduce peak load. For example, the ACEEE has identified six targeted programs to reduce peak electrical demand (2 residential, 4 commercial) focused on improvements in HVAC equipment, building retro-commissioning, and commercial lighting.[7] These programs were chosen as "cost-effective relative to other peak demand supply or peak demand reduction options, particularly when the value of both energy and peak demand savings are included in the analysis." In other words, the ACEEE endorses solutions which achieve significant and relevant peak load reductions without sacrificing total annual energy savings. The potential peak savings from these programs after 10 years is estimated to be nearly 64,000 MW, 56 times greater than the potential 10 year peak savings from the proposed SHGC reductions. Similarly, the peak savings from current efficiency standards for appliances is estimated to be 66,000 MW in 2010, with potential for an additional 17,000 MW peak savings if other proposed programs are enacted.[13] The potential summer peak load savings from reducing SHGC in the central region is trivial by comparison and within the margin of error of these estimates, not to mention the adverse impacts it would have on winter energy usage and the pyrolytic low-e manufacturing sector.

Winter Peak Load

Although we consider the peak load impact from windows to be minimal in the Upper Central and Northern regions, it is noted that the DOE only considered the summer peak load due to cooling. The impact on winter peak loads was ignored. This omission is especially important in regions where a significant portion of homes still use electrical heating, such as the Pacific Northwest and New England. In these regions, the winter peak load can be larger than the summer peak load, as evidenced by higher residential electrical costs in the winter.[14] These peak periods occur in the mid-morning and during the afternoon commute, when passive solar heating from higher SHGC windows will reduce heating requirements. The proposed criteria will eliminate high SHGC products from the Upper Central, as well as jeopardize the availability of these products in the North.

2.4 Greenhouse Gas Emissions, Pollution Prevention Impact

The DOE did not perform any specific analysis on air emissions with regard to the two proposals, but they repeatedly state that cooling savings would reduce pollution more than heating savings, and cite the corresponding primary carbon emission rates associated with electricity and natural gas.[12] However, by simply applying these rates to the energy savings potential shown in Table 2, it is clear that the four-zone proposal will reduce CO_2 emissions (greenhouse gas) by at least 14% more than the three-zone proposal. This number is actually underestimated because of the error regarding the placement of Reno in the three-zone proposal, and the fact that a significant numbers of homes use electricity-based heating (29% nationwide).[3] The results are shown in the table below after making these corrections. The four-zone proposal has 18% better potential carbon emission savings than the three-zone proposal.

Carbon Emission Potential Reductions relative to current sales (million MT)

Scenario	Total
Current Energy Star	125
Three-Zone (corrected)	159
Four-Zone	188

[13] T. Kubo, H. Sachs, S. Nadel, *Opportunities for New Appliance and Equipment Efficiency Standards: Energy and Economic Savings Beyond Current Standards Programs*, American Council for an Energy-Efficient Economy, Washington D.C., Sep 2001.

[14] For example, see delivery rates published by the Snohomish Public Utility District (www.snopud.com/finance/ratesked.htm) and the Maine Public Utility Commission (www.state.me.us/mpuc/er-page.htm).

It is shocking that the DOE uses the rationale that the three-zone would save more pollution by saving more cooling energy (page 3 of the reference 2), but if they had done this simple calculation, they would have found the data did not support their conclusion.

Others have falsely claimed that there is a high amount of pollution associated with electrical peak demand. However, clean natural gas turbines are favored for peak power plants due to their fast start-up, high efficiency, low emissions, low capital, and relatively short construction time. Gas-fired plants accounted for 95% of all capacity added to the electric grid in 2000 (22,238 MW out of 23,453 MW total additions).[15]

2.5 Consistency with Energy Codes

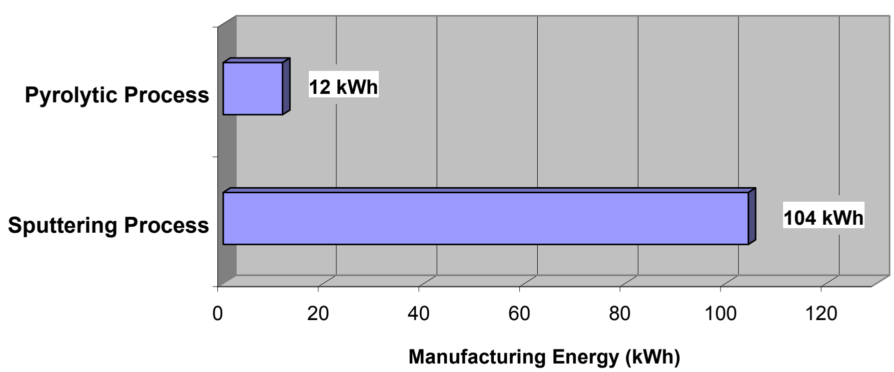
The DOE has stated their intention to be consistent or more stringent than the IECC. The IECC severely limits passive solar heat gain to a 0.40 SHGC or less in climate regions below 3500 HDD. In regions above 3500 HDD, however, the IECC allows the unrestricted use of solar heat gain to help reduce the need for residential winter heating. The three-zone proposed criteria is inconsistent with the IECC's decision to allow unrestricted SHGC above 3500 HDD. As a result, the proposed criteria will result in an actual decreased stringency of window energy performance above 3500 HDD (see energy analyses above). Furthermore, in its comprehensive IECC revision proposal, the DOE also decided to allow unrestricted SHGC beyond 3500 HDD, in part justified by the analysis performed at Pacific Northwest National Laboratory.[9] The DOE's inconsistency between these two programs is clear.

The four-zone proposal is more consistent with the IECC, in that it also allows unrestricted SHGC above 3500 HDD, and more closely follows the important climate boundaries in the IECC.

2.6 Energy Consumption of Low-E Manufacturing Processes

Another factor not considered by the DOE is the energy consumed in the different low-e manufacturing processes, as the soft coat process uses up to 9 times more energy to produce low E glass than the hard coat process. To meet the three-zone proposed criteria for the South and Central regions, soft coat low-e will be required. Soft coat products also currently account for 80-85% of low-e glass sold in the North. In this off-line process, finished glass is removed from the float line and taken to an off-line location where, using an electrically powered vacuum process, a low-emissivity coating is applied. The soft-coat process uses far more electrical energy than the hard-coat process, which applies the coating on the float line while the glass is being formed. In the hard coat process, the glass emerges from the float line already coated. No additional energy is required to move the glass to an off-line location and no additional electrical energy is needed to operate vacuum chambers to apply the coating.

Manufacturing Energy Requirements to produce 300 ft2 of coated glass



More specifically, a typical sputtering line consumes 2-3 MW to produce approximately 7000 ft^2 / hr of salable glass. The hard coat process consumes only 1 MW to produce over three times as much coated glass (25,000 ft^2/hr).

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[15] *Electric Power Annual 2000 Vol. 1*, Energy Information Administration, U.S. Department of Energy, Washington D.C., Aug 2001.

Stated another way, the soft coat process consumes 9 times as much energy as the hard coat process to produce the same amount of glass. Although this issue was raised at the March 20, 2002 meeting,[16] the DOE never addressed or considered the impact of the manufacturing process on both total energy consumption and peak load.

2.7 Instability of Soft Coat Low E Glass Characteristics

DOE's calculations for energy consumption and peak load assume, without any supporting data, that the U factor and SHGC properties for soft coat Low E glass are stable over the useful life of the window. However, window manufacturers employing soft coat Low E glass have not made any such representation about the stability of the U factor and SHGC properties of their windows over any prolonged time frame, nor do those manufacturers provide any warranty for the U factor and SHGC properties. Their warranties only cover other aspects of the windows such as seal life before visible condensation occurs, but the U factor and SHGC properties are not warranted for any period of time. In contrast, the pyrolytic coatings that provide the U factor and SHGC properties for hard coat Low E glass are extremely stable over the 40 year useful life of the window. The DOE should request stability data from the soft coat Low E glass manufacturers to evaluate changes in U factor and SHGC properties. This evaluation should be performed to determine this impact before and after seal failure and during transport and storage of soft coat Low E glass prior to window fabrication.

3. Prescriptive vs. Performance Based Criteria

3.1 Limitations of Current and Proposed Criteria

Both the current program and the two proposals are limited in that they focus on arbitrary criteria without properly considering overall performance. In the North, only a U requirement is specified. However, it is inaccurate and simply wrong to treat a window as if it were an opaque wall, ignoring the effect of light coming through the window. To accurately compare window performance, the solar heat gain must also be considered, as its impact on energy consumption can be the same or even larger than that due to the U factor. Ignoring the SHGC in the North allows products which block out the warmth of the sun in winter to still qualify for the Energy Star label, despite inferior performance. This misleads the consumer.

The best solution is a true performance based standard, which appropriately reflects the tradeoffs between U and SHGC in each region. For instance, an aluminum window with U = 0.42 should not be excluded in the south central region if it has an appropriately low SHGC to give the same overall energy performance. Likewise, a low-e window with U = 0.38 should not be excluded in the northern region if it has an appropriately high SHGC to give the same overall energy performance. Prescriptive criteria without any allowance for tradeoffs can seriously affect certain product groups, even if they can demonstrate equivalent performance. Building codes recognize the need to allow tradeoffs, and ENERGY STAR's neglect of this issue is unacceptable.

A performance based standard is not any more complex than the current system. For example, the equations and method for determining U and SHGC values are extremely complex, yet there are computer tools to make this easy such as WINDOW and THERM, and this is not viewed as problematic in the current ENERGY STAR system. Likewise, U and SHGC tradeoff equations or tables could easily be incorporated into even simpler computer tools and labeling software for the window manufacturer. The outcome to the consumer is the same … the simple and clear ENERGY STAR label.

Performance based systems are either already used or being actively developed in Europe, Canada, Britain, Denmark, and Australia. By continuing to focus on rigid prescriptive criteria, the U.S. is clearly falling behind the rest of the world. The Department and industry has suffered through two years of controversy and frustration over the ENERGY STAR program. To resolve this issue, the Department has no other choice than to step back, and take the time to develop an appropriate and fair performance based standard. We will be happy to assist in this process.

3.2 Anti-Competitive Impact

With such diverse climates in the U.S., it is impossible for one type of glazing to provide the best overall performance in all regions of the country. DOE's three-zone proposal, which promotes using one type of glazing

[16] Transcript, Energy Star for Windows Meeting with Industry Stakeholders, U.S. Department of Energy, Washington D.C., March 20, 2002.

everywhere to achieve superior performance in energy efficiency, misleads the consumer. Proposing criteria that allow a single product to receive the ENERGY STAR label in all regions undermines the credibility of the ENERGY STAR Program. A product that performs well in Miami will not perform as well in Boston, which deceives the consumers in Boston. Miami is clearly a cooling dominated climate while Boston is clearly heating dominated. To promote the same window as being energy efficient in both cities is unconscionable and simply wrong. The Bostonian's energy needs are significantly different than the Floridian, as the Bostonian welcomes passive solar energy to reduce his energy bills (heating) and the Floridian rejects solar energy to reduce home energy consumption (air conditioning). DOE should not let the threat of several large window manufacturers, who, for the sake of personal convenience, plan to use ENERGY STAR's marketing message only on products which qualify in all regions, sway them from proposing criteria which provide the best overall energy performance. There exist numerous other parties who are willing and able to maintain and enhance the credibility of the ENERGY STAR Program.

Furthermore, the prescriptive requirements have an anticompetitive impact on the U.S. marketplace. In both the current ENERGY STAR and proposed criteria, products with a equivalent or superior performance are being excluded in the northern zone, such as products with U somewhat over 0.35 but with high SHGC. In a recent case study by Mattinson, DePaola, and Arasteh where window retrofit options were evaluated in Madison, WI, the comparison of ENERGY STAR windows and non-ENERGY STAR windows resulted in unsettling conclusions.[17] In their analysis, a window meeting ENERGY STAR criteria (U = 0.34 and SHGC = 0.34) would have the same impact on energy costs as a window *not* meeting ENERGY STAR (U = 0.40 and SHGC = 0.54). Despite equal performance, the second window would not be able to carry the ENERGY STAR label. Similarly, the Efficient Windows Collaborative has numerous examples of windows that are denied an ENERGY STAR label, but have superior energy performance. By endorsing one window as energy efficient, but not the other, the Department of Energy has established an anticompetitive environment in the marketplace, favoring one technology over its competition.

Legal Authority for DOE's Energy Star proposal

DOE's Energy Star proposal for windows exceeds the legal authority granted to the DOE in Section 127 of the Energy Policy Act of 1992 and any other statutory authority granted to the DOE and/or the U.S. Environmental Protection Agency.

[17] W. Mattinson, R. DePaola, D. Arasteh, "What should I do about my Windows?" *Home Energy Magazine*, July/August 2002. Compare windows 8-high and 8-low.